DYMAR ELECTRONICS LIMITED

WATFORD ENGLAND

A.F. WAVE ANALYSER
TYPE 1771

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1. GENERAL DESCRIPTION.

The Dymar A.F. Wave Analyser Type 1771 is an instrument for the analysis of complex waveforms and the evaluation of distortion and intermodulation products in the Audio Frequency range. It can be set to give either direct voltage readings or, as is more common, to read directly in db relative to a convenient datum level, usually 0 db.

As a selective voltmeter it features a high sensitivity of 30 μV f.s.d. and since the instrument uses the superheterodyne technique, the selectivity is constant and independent of the tuned frequency. The I.F. Amplifier uses crystal filters to provide sharp selectivity.

For relative measurements a 60 db range switch is used, the range scales being mechanically coupled to the input attenuator switch, giving an unambiguous indication of the meter full scale sensitivity.

The frequency range covered is 20 Hz to 50 kHz, and a "band spread" range of 20 Hz to 5 kHz is included to provide easier tuning in the frequency band which is of main interest.

The instrument can be operated from A.C. mains, or from its own rechargeable batteries, and thus can be used in the field as well as in the laboratory. In addition, it incorporates a "B.F.O." with 0.5 Volts output and a "Restored Output" facility.

2. SPECIFICATION.

Frequency Range:	20 Hz - 5 kHz 20 Hz - 50 kHz
Voltage Range:	30μ V f.s.d. -300 V f.s.d. in 15 ranges of 1-3-10 sequence
Selectivity:	3 db ± 5 Hz 40 db ± 50 Hz 60 db ± 100 Hz 70 db ± 200 Hz
Input Impedance:	1 M ohm on all ranges
Frequency Accuracy	5% ± 50 Hz (After Calibration
Voltmeter Accuracy	5% (After Calibration
Selective Measurements:	Down to -74 db with respect to fundamental frequency for levels greater than 30 mV
Residual Noise:	Better than 80 db
Intermodulation Distortion:	Better than 70 db
Restored Output:	0.5 V at f.s.d.
Output Impedance:	600 ohm nominal
B.F.O. Output:	100 Hz - 50 kHz (0.5 db points)
Output Level:	0 - 0.5 V e.m.f.

External Power Supply:	190 - 260 Volts 95 - 130 Volts 50 - 60 Hz or 22 - 32 Volts DC at 50mA
Internal Battery:	24 Volt nominal Nickel Cadmium rechargeable battery of 400 mAh capacity giving a typical operating time of 8 hours between recharging. Batteries are recharged, in situ, by means of an internal charging circuit, in 14 hours from a fully discharged condition (22 Volts)
Meter:	Precision 5 inch movement with mirror backed scale calibrated 0 - 10, 0 - 3 and a db scale of -12 to +2 db for relative measurements. A "Check Battery" push button connects meter across battery to read voltage directly.
Dimensions and Weight:	Width Height Depth Weight 16½ 6½ 8" 15lb 42 cm 16.5cm 20 cm 6.7 kg.
Accessories:	Rack Mounting Adaptor Kit Type 1801. Protective Front Panel Cover Type 1802

Typical figures based on normal operating conditions.

Dymar policy is one of continuous improvement, therefore, the right is reserved to change specifications without notice.

3. OPERATION.

3.1. Power Supply

The instrument is normally despatched from the factory set for 230V operation, and no further tap changes or adjustments are necessary provided the mains voltage is between 190 and 260 Volts A.C. If the mains voltage is in the range 95 to 130 Volts A.C., then the primary windings on the transformer have to be connected in parallel, instead of in series. In order to do this, remove the cover from the instrument, and make the following adjustments on the power supply board which is situated behind the meter. Remove the link which connects the two pins marked 230 V, and substitute it with two links across pins marked 115V. Also replace the 150 mA fuse with an equivalent type rated for 300 mA.

To operate the instrument from the mains supply, push the red button marked "Mains", which will then light up.

To operate the instrument from its own internal battery, first check the battery voltage by depressing the green button, when a reading of not less than 22volts on the 30 volt scale should be obtained, and then push in the blue button only. This button does not light up, in the interest of prolonging battery life. If the battery voltage is less than 22 volts, the batteries require recharging, this is done by depressing the red and blue buttons, when the instrument will be both operational from the mains and charging its own batteries. A discharged battery of 22 volts or less will require 14 hours of charging to bring it up to its full charge.

To operate the instrument from an external battery, connect it to the two sockets at the back, and push the slider switch to "External Battery",

and then proceed as before. The battery should have a nominal voltage of 24 volts, but the instrument will operate satisfactorily between 22 and 32 volts D. C.

3.2. Controls

Switch on the power supply and allow about 5 minutes for the instrument to warm up.

The following front panel controls are available to the user:-

(1) Input Attenuator switch, marked "Max. Input". This has nine positions from 30μV full-scale deflection to 300V full-scale deflection in 1, 3, 10 sequence, and a tenth position marked "Cal.", when the input socket is disconnected from the attenuator and connected to B. F. O. signal taken via suitable resistive divider.

(2) A Meter Range Switch, marked "Range". This selects the full-scale sensitivity of the meter, and its range setting is dependent on the position of the input attenuator switch. It has seven positions, and as an example, when the input attenuator switch is set to 30 mV, the ranges displayed on the "Range Switch" are from 30 mV to 30μV full-scale deflection. An auxiliary db scale from 0 to 60 db facilitates relative measurements in decibels.

(3) The Main Frequency Tuning Dial. This is a slow motion dial which selects the frequency component being resolved by the analyser. It has two scales, one reading 0 to 5 kHz, and

another reading 0 to 50 kHz.
An auxiliary tuning control marked "Fine" allows for very fine adjustments in the tuning.

(4) The Frequency Range Switch.
This is a two-position switch, selecting either the 5 kHz range or the 50 kHz range of the oscillator.

(5) The Variable Gain Potentiometer, concentric with the "Max. Input" switch. This allows the gain of the amplifiers to be adjusted to a convenient figure, e.g. 0 db, when relative voltage levels are required. In its maximum clockwise position, the instrument is calibrated in absolute values.

(6) The Voltage Calibration preset potentiometer. This allows the gain of the instrument to be calibrated at any frequency between 200 Hz and 45 kHz when the "Max. Input" switch is in the "Cal" position.

(7) Restored & cal. freq. /B.F.O & cal. F.S.D. switch.
The position of this switch determines the mode of operation of the Analyser.

(8) Set Output Level potentiometer, marked "Level". The output level, B.F.O. or Restored, can be set to the required level; clockwise for maximum.

(9) Frequency trim preset, marked "Cal. Freq."
This is situated above the frequency range switch, and it allows the local oscillator frequency to be calibrated

when the main tuning dial is set to 0 Hz.

3.3. Calibration

Set the "Max. Input" switch and the "Range" switch to positions marked "Cal.".

Set the frequency range switch to 0 - 50 kHz range, and the frequency dial to 0 Hz.

Set the "Fine" frequency control to its central position, that is with the white dot on the knob at "12 o'clock".

Set the Restored/B.F.O. switch to the "Restored" mode of operation.

By means of the "Cal. Freq." trim preset, peak the break-through of the oscillator signal through the crystal filter. The break-through will be about 1/10 of f.s.d.

Should it be less than that, or should some difficulty be encountered in finding the break-through point, turn the "Range" switch to - 10 db, thus increasing the sensitivity of the voltmeter. After calibrating the frequency, return the "Range" switch to the "Cal." position. Set the Restored/B.F.O. switch to the B.F.O. mode of operation.

Set the frequency dial anywhere between 200 Hz and 45 kHz.

By means of the Voltage Calibration preset potentiometer, set the level to full-scale deflection.

The instrument is now calibrated and ready for use.

3.4. Operation as a tuned voltmeter

Restored/B.F.O. switch in "Restored" mode of operation.

Apply the unknown voltage to the input terminals, and with the range switch set to 0 db, select a suitable input voltage range and search with the tuning dial until a deflection is obtained. Adjust the ranges either up or down to get a suitable peaked reading as the voltmeter is tuned. The maximum reading that can be obtained on the meter is the required measured voltage.

3.5. Operation as a relative voltage level meter

Restored/B.F.O. switch in "Restored" mode of operation.

With the range switch set to 0 db, select an input attenuator range which will give a suitable reading for the response to the fundamental or major frequency component. Using the variable gain potentiometer, adjust this fundamental reading to a convenient value, e.g. 0 db. One can now search for other frequency components of the applied wave-form, such as harmonic products or intermodulation products, by increasing the sensitivity of the range as required, and tuning the voltmeter for maximum response. The relative level of this response can be measured directly in decibels on the red scale.

As an example, it is desired to find the harmonic content of, say, a 1 kHz square wave. Tune the voltmeter for maximum response at 1 kHz, and with the range switch set to 0 db, adjust the variable gain control to 0 db on the meter. Now tune to 2 kHz and increase the sensitivity on the range switch to obtain a peaked

reading; it is found that a 2 kHz the meter reads - 8 db when the range switch is at -30 db, therefore, the second harmonic is at - 38 db below the fundamental. Now tune to 3 kHz to get a suitable reading, and the reading will be + 2 db when the range switch is set to - 20 db; therefore, the third harmonic of the applied wave is - 18 db.

Further components can be resolved in a similar manner.

3.6. Operation as beat frequency oscillator (B.F.O.)

Set the Restored/B.F.O. switch in B.F.O. mode of operation.

Connect the "Input" and "Output" sockets together. Using the "Level" control and the "Max. Input" switch, set the B.F.O. output level to the required reference level. Remove the "Input" and "Output" connection.

Connect the "Output" of the Analyser to the input of the network under test, and the output of the network to the "Input" of the Analyser.

Using the "Range" and "Max. Input" switches, the frequency response of the network can now be taken.

4. TECHNICAL DESCRIPTION.

The circuit description should be read in conjunction with the attached circuit and component layout diagrams of the instrument.

The signal to be measured is fed from the input socket SK1 to the input attenuator switch (S1A and S1B) which gives either 0 db attenuation, 30 db attenuation of 60 db attenuation. It is frequency compensated with the trimmers C2 and C4. A directly coupled buffer amplifier comprising VT21 and VT22 drives the variable gain potentiometer RV1. When the slider of this potentiometer is in its uppermost position, the instrument gives maximum gain. The range of adjustment on this gain control is approximately 10 db. The signal is then applied to the input attenuator switch, which provides 10 db attenuation steps. Next the signal is applied to the input amplifier consisting of VT23, VT1 and VT2. Large negative feedback is taken from the emitter of VT2 and applied to VT23 to obtain greater linearity. This is followed by the low pass filter which has a cut-off frequency of 50 Hz, so as to reduce any spurious 100 Hz signals breaking through directly into the I. F. amplifier.

The signal is then applied to the balanced mixer consisting of diodes D1 to D4 whose other input, through the transformer T1, is the signal from the local oscillator. The required heterodyne frequency from this mixer is 100 kHz, and is applied to the first I. F. amplifier, VT3.

The local oscillator breakthrough into this stage is minimised by adjusting the balancing potentiometers RV2 and RV3.

VT3 drives the first crystal filter which consists of XL1 and XL2 whose series resonant

frequencies are 10 Hz a part.

The signal is then applied to the second I.F. amplifier stage VT4 and VT5 which drives the second crystal filter XL3 with its compensating trimmer capacitor C27. All the selectivity of the instrument is contained within those two crystal filters.

The third I.F. amplifier stage VT6 and VT7 which follows, drives the I.F. attenuator S2. This gives 0 db to 60 db attenuation in 10 db steps. This signal is now applied to the meter amplifier and detector, which consists of the emitter follower VT8 and the two feedback amplifier pairs VT9, VT10, and VT11, VT12.

The meter rectifiers D5 and D6 are included in the feedback circuit to give linear rectification characteristics. The rectified output is then applied, via the preset "Cal" potentiometer, to the meter in the Dymar Meter Unit.

The local oscillator which covers the ranges of 100 kHz to 150 kHz, and 100 kHz to 105 kHz, consists of the transistor VT17 connected in a grounded base configuration. Tuning is effected by the main tuning capacitor C76, while the "Fine" tuning adjustments are made by means of the potentiometer RV8. This potentiometer varies the d.c. bias applied to the variable capacitance diode D11 which is loosely coupled to the oscillator tank circuit. A small series coil L6 permits frequency trimming of the local oscillator during calibration.

The buffer stage, consisting of the double emitter follower VT18 and VT19, isolates the oscillator from the main balanced mixer which it drives.

The other output is taken from the oscillator via the emitter follower VT20 and fed to the output mixer.

In the "Restored" mode of operation, the I.F. voltage, picked off the emitter of VT12, is also fed to the "Output Mixer". The resulting difference frequency which is identical to the original frequency component applied at the input, is filtered in the low pass filter L4, L5, C52, C53, C54 and C55, and applied to the amplifier VT14 and VT15; this signal is then fed to the output sockets on the front panel via the emitter follower VT16.

In the B.F.O. mode of operation, the switch S3 disconnects the I.F. signal from the output mixer, activates the 100 kHz crystal-controlled and Zener-stabilised oscillator, and connects the oscillator to the output mixer. The frequency fed into the output sockets is now the difference frequency between that of the local oscillator and the 100 kHz crystal oscillator. Thus, in the B.F.O. mode of operation, the selective voltmeter is automatically tuned into the output frequency.

The resistive divider comprising resistors R102, R103, R111 and pre-set RV6, provides the reference voltage for calibrating the selective voltmeter amplifiers. With the "Max. Input" attenuator switch in the "Cal." position the reference voltage is fed into the input stage VT21.

Power Supply

The design of the power supply is conventional and consists of transformer T1 and rectifying diodes D3 and D4 providing unsmoothed D.C. across capacitor C7. This voltage, of 24 volts, is then applied to the regulator which provides a highly stable voltage of 12.6V at pin 1 of SK1.

The reference voltage used is the Zener diode D1, and the difference amplifier comprises VT3 and VT4. RV1 adjust the voltage to 12.6 volts precisely. The series element of the regulator is VT1 which is driven by the emitter follower VT2. The collector load of VT4 is returned to a stabilised voltage of about 18V (5.6V relative to 12.6V) from across Zener Diode D2, and this voltage is applied to series transistor VT5 providing a partially stabilised voltage of 18 volts at pin 2.

The same regulator is used to stabilise the voltage of the internal (or external) battery of 24 Volts if used.

The internal battery is recharged by the voltage doubling circuit of D5, D6, C5 and C6 through resistor R9.

5. ALIGNMENT PROCEDURE.

If re-alignment of the instrument is required, withdraw the right-hand or "Plug-in" unit, by releasing the two Phillips-type screws on the back panel. All test points and pre-set controls are now accessible for adjustment.

Do not adjust these controls unless adequate test gear is available for the proper calibration of the instrument.

The following test gear is required: a high-grade valve voltmeter, frequency counter, oscilloscope and audio signal generator.

5.1. Adjustment of the Input Attenuator

Set the input attenuator switch to 1 V and apply a low frequency signal, e.g. 400 Hz of approximately 1V amplitude, and then tune to obtain a maximum reading on the meter. Apply the same amplitude signal, but at 40 kHz, and again tune for a maximum. Adjust C2 to make these maxima identical. Repeat the same procedure on the 30 V range, adjusting C4 to equalise the low and high frequency meter reading.

5.2. Adjustment of balanced mixer

Set the Restored/B.F.O. switch to "Restored", the meter "Range" switch to 0 db, and the frequency dial to 0 Hz. In this mode the local oscillator is set to 100 kHz, and there should be break-through from the oscillator into the I.F. filter at this frequency. If the break-through is not present, search for it using the "Freq. Cal." control. Adjust the potentiometers RV2 and RV3 to reduce this break-through to minimum, if necessary increasing the range switch sensitivity. The break-through should be less than 10% of f.s.d. at the 0 db setting.

5.3. Second crystal filter compensation

Apply 30 mV at 1 kHz to the input and tune the Wave Analyser for a maximum reading. Detune the input frequency by either plus or minus 50 Hz, and by increasing the sensitivity on the Range switch, check the filter response on the skirts and if necessary adjust C27 to make this response sensibly symmetrical with respect to the centre frequency.

5.4. Preset adjustment of instrument gain

Should it be found at any time that the adjustment of the "Cal" preset potentiometer on the front panel is inadequate, it may be necessary to either increase or decrease the feedback resistor R56 to bring the overall gain of the amplifiers within the adjusting range of the potentiometer. If there is not sufficient gain, R56 should be increased, if there is too much gain it should be decreased in value.

5.5. Local oscillator adjustment

Before adjusting and tracking of this oscillator is attempted, the instrument should be allowed to stabilise itself thermally, that is, it should be running for at least 15 minutes, and preferably half an hour. The procedure must be strictly adhered to, as the various preset controls are interdependent.

The "Fine" tuning control and the "Freq. Cal." tuning coil L6 must be in their central positions.

(1) Set the frequency range switch to the 0 to 50 kHz position, and the Restored/B.F.O. switch to "Restored". Set the frequency dial to 0 Hz, and adjust L7 (the main tank circuit coil) to peak

the break-through of the oscillator signal through the crystal filter.

(2) Apply a suitable voltage at 50 kHz from a signal generator to the "Input", and with the tuning dial set to 50 kHz, adjust the trimmer capacitor C74 for maximum response.

(3) Readjust L7, if necessary, at 0 Hz frequency, and again C74 at 50 kHz. This is necessary as an adjustment in one control slightly affects the other.

(4) Set the frequency range switch to the 0 to 5 kHz position. Set the frequency dial to 0 Hz, and adjust C67 to peak the break-through of the oscillator signal through the crystal filter.

(5) Apply a suitable voltage to the "Input" at 5 kHz from a signal generator, and with the tuning dial set to 5 kHz, adjust the trimmer capacitor C69 for maximum response.

Repeat this procedure, adjusting C67 at 0 Hz and C69 at 5 kHz until the tracking is satisfactory. These two adjustments are very much interdependent, and this procedure may have to be repeated up to five times to get satisfactory tracking.

5.6. Adjustment of 100 kHz crystal oscillator

Set the "Max. Input" switch to the "Cal." position and the Restored/B.F.O. switch to the "B.F.O." position. Adjust C46 for maximum response on the meter.

5.7. Adjustment of the calibrating voltage

Set the "Max. Input" switch to the "Cal." position and the Restored/B.F.O. switch to the

"B. F. O." position. Set the frequency dial at any frequency between 200 Hz and 45 kHz. Connect an accurate A. C. voltmeter at the junction of R102 and R103 (point "W" on the circuit diagram) and adjust RV6 to obtain a reading of 31, 6mV.

6. COMPONENTS LIST

Circuit Ref.	Description	Value	Tol. %	Rating
6.1 Resistors				
R1	Carbon H.S.	1M	0.5	$\frac{1}{4}$W
R2	Carbon Film	1M	5	$\frac{1}{4}$W
R3	Carbon H.S.	32.7K	0.5	$\frac{1}{4}$W
R4	Carbon H.S.	1K	0.5	$\frac{1}{4}$W
R5	Carbon Film	47K	5	$\frac{1}{4}$W
R6	Carbon Film	33K	5	$\frac{1}{4}$W
R7	Carbon Film	2.7K	5	$\frac{1}{4}$W
R8	Carbon Film	3.9K	5	$\frac{1}{4}$W
R9	Carbon Film	220	5	$\frac{1}{4}$W
R10	Carbon Film	22K	5	$\frac{1}{4}$W
R11	Carbon Film	15K	5	$\frac{1}{4}$W
R12	Carbon H.S.	21.5K	0.5	$\frac{1}{4}$W
R13	Carbon H.S.	6.8K	0.5	$\frac{1}{4}$W
R14	Carbon H.S.	3.14K	0.5	$\frac{1}{4}$W
R15	Carbon Film	2.2M	5	$\frac{1}{4}$W
R16	Carbon Film	3.3M	5	$\frac{1}{4}$W
R17	Carbon Film	5.6K	5	$\frac{1}{4}$
R18	Carbon Film	220	5	$\frac{1}{4}$W
R19	Carbon Film	1.5K	5	$\frac{1}{4}$W
R20	Carbon Film	1.5K	5	$\frac{1}{4}$W
R21	Carbon Film	33K	5	$\frac{1}{4}$W
R22	Carbon Film	10K	5	$\frac{1}{4}$W
R23	Carbon Film	4.7K	5	$\frac{1}{4}$W

Circuit Ref.	Description	Value	Tol. %	Rating
R24	Carbon Film	330	5	$\frac{1}{4}$W
R25	Carbon Film	1.5K	5	$\frac{1}{4}$W
R26	Carbon Film	1K	5	$\frac{1}{4}$W
R27	Carbon Film	470	5	$\frac{1}{4}$W
R28	Carbon Film	1K	5	$\frac{1}{4}$W
R29	Carbon Film	470	5	$\frac{1}{4}$W
R30	Carbon Film	470	5	$\frac{1}{4}$W
R31	Carbon Film	470	5	$\frac{1}{4}$W
R32	Carbon Film	820	5	$\frac{1}{4}$W
R33	Carbon Film	220	5	$\frac{1}{4}$W
R34	Carbon Film	1K	5	$\frac{1}{4}$W
R35	Carbon Film	820	5	$\frac{1}{4}$W
R36	Carbon Film	1K	5	$\frac{1}{4}$W
R37	Carbon Film	820	5	$\frac{1}{4}$W
R38	Carbon Film	820	5	$\frac{1}{4}$W
R39	Carbon Film	1K	5	$\frac{1}{4}$W
R40	Carbon Film	820	5	$\frac{1}{4}$W
R41	Carbon Film	10K	5	$\frac{1}{4}$W
R42	Carbon Film	10K	5	$\frac{1}{4}$W
R43	Carbon Film	47K	5	$\frac{1}{4}$W
R44	Carbon Film	1K	5	$\frac{1}{4}$W
R45	Carbon Film	2.2K	5	$\frac{1}{4}$W
R46	Carbon Film	8.2K	5	$\frac{1}{4}$W
R47	Carbon Film	10K	5	$\frac{1}{4}$W
R48	Carbon Film	330	5	$\frac{1}{4}$W
R49	Carbon Film	22K	5	$\frac{1}{4}$W

Circuit Ref.	Description	Value	Tol. %	Rating
R50	Carbon Film	220	5	$\frac{1}{4}$W
R51	Carbon Film	4.7K	5	$\frac{1}{4}$W
R52	Carbon Film	4.7K	5	$\frac{1}{4}$W
R53	Carbon Film	1.5K	5	$\frac{1}{4}$W
R54	Carbon Film	100	5	$\frac{1}{4}$W
R55	Carbon Film	10K	5	$\frac{1}{4}$W
R56	Carbon Film	12K	5	$\frac{1}{4}$W
R57	Carbon Film	330	5	$\frac{1}{4}$W
R58	Carbon Film	1K	5	$\frac{1}{4}$W
R59	Carbon Film	1K	5	$\frac{1}{4}$W
R60	Carbon H.S.	200	0.5	$\frac{1}{4}$W
R61	Carbon H.S.	1.23K	0.5	$\frac{1}{4}$W
R62	Carbon H.S.	390	0.5	$\frac{1}{4}$W
R63	Carbon H.S.	1.23K	0.5	$\frac{1}{4}$W
R64	Carbon H.S.	390	0.5	$\frac{1}{4}$W
R65	Carbon H.S.	123	0.5	$\frac{1}{4}$W
R66	Carbon H.S.	39	0.5	$\frac{1}{4}$W
R67	Carbon H.S.	18	0.5	$\frac{1}{4}$W
R68	Carbon Film	1M	5	$\frac{1}{4}$W
R69	Carbon Film	1M	5	$\frac{1}{4}$W
R70	Carbon Film	10K	5	$\frac{1}{4}$W
R71	Carbon Film	4.7K	5	$\frac{1}{4}$W
R72	Carbon Film	10K	5	$\frac{1}{4}$W
R73	Carbon Film	330	5	$\frac{1}{4}$W
R74	Carbon Film	15K	5	$\frac{1}{4}$W
R75	Carbon Film	33K	5	$\frac{1}{4}$W

Circuit Ref.	Description	Value	Tol. %	Rating
R76	Carbon Film	220	5	$\frac{1}{4}$W
R77	Carbon Film	3.9K	5	$\frac{1}{4}$W
R78	Carbon Film	3.9K	5	$\frac{1}{4}$W
R79	Carbon Film	4.7K	5	$\frac{1}{4}$W
R80	Carbon Film	15K	5	$\frac{1}{4}$W
R81	Carbon Film	10K	5	$\frac{1}{4}$W
R82	Carbon Film	180	5	$\frac{1}{4}$W
R83	Carbon Film	220	5	$\frac{1}{4}$W
R84	Carbon Film	3.9K	5	$\frac{1}{4}$W
R85	Carbon Film	100	5	$\frac{1}{4}$W
R86	Carbon Film	3.9K	5	$\frac{1}{4}$W
R87	Carbon H.S.	2.2K	0.5	$\frac{1}{4}$W
R88	Carbon Film	15K	5	$\frac{1}{4}$W
R89	Carbon Film	10K	5	$\frac{1}{4}$W
R90	Carbon Film	10K	5	$\frac{1}{4}$W
R91	Carbon Film	1K	5	$\frac{1}{4}$W
R92	Carbon Film	1K	5	$\frac{1}{4}$W
R93	Carbon Film	1K	5	$\frac{1}{4}$W
R94	Carbon Film	220	5	$\frac{1}{4}$W
R95	Carbon H.S.	220	1	$\frac{1}{4}$W
R96	Carbon H.S.	220	1	$\frac{1}{4}$W
R97	Carbon H.S.	470	1	$\frac{1}{4}$W
R98	Carbon H.S.	470	1	$\frac{1}{4}$W
R99	Carbon H.S.	170	1	$\frac{1}{4}$W
R100	Carbon H.S.	2.8K	1	$\frac{1}{4}$W
R101	Carbon H.S.	170	1	$\frac{1}{4}$W

Circuit Ref.	Description	Value	Tol. %	Rating
R102	Carbon H.S.	1K	1	$\frac{1}{4}$W
R103	Carbon H.S.	9K	1	$\frac{1}{4}$W
R104	Carbon Film	1.5K	5	$\frac{1}{4}$W
R105	Carbon Film	330	5	$\frac{1}{4}$W
R106	Carbon Film	10K	5	$\frac{1}{4}$W
R107	Carbon Film	4.7K	5	$\frac{1}{4}$W
R108	Carbon Film	220K	5	$\frac{1}{4}$W
R109	Carbon Film	2.7K	5	$\frac{1}{4}$W
R110	Carbon Film	3.9K	5	$\frac{1}{4}$W
R111	Carbon H.S.	15K	1	$\frac{1}{4}$W
R112	Carbon Film	5.6K	5	$\frac{1}{4}$W
R113	Carbon Film	47K	5	$\frac{1}{4}$W
R114	Carbon Film	47K	5	$\frac{1}{4}$W
R115	Carbon Film	220K	5	$\frac{1}{4}$W
R116	Carbon Film	1K	5	$\frac{1}{4}$W
R117	Carbon Film	330	5	$\frac{1}{4}$W
R118	Carbon Film	560	5	$\frac{1}{4}$W
R119	Carbon Film	10K	5	$\frac{1}{4}$W
R120	Carbon Film	220	5	$\frac{1}{4}$W
R121	Carbon Film	10K	5	$\frac{1}{4}$W
R122	Carbon Film	33K	5	$\frac{1}{4}$W
R123	Carbon Film	10K	5	$\frac{1}{4}$W
R124	Carbon Film	10K	5	$\frac{1}{4}$W
R125	Carbon Film	100K	5	$\frac{1}{4}$W
R126	Carbon Film	100K	5	$\frac{1}{4}$W
R127	Carbon Film	1K	5	$\frac{1}{4}$W

Circuit Ref.	Description	Value	Tol. %	Rating
R128	Carbon Film	1K	5	$\frac{1}{4}$W
R129	Carbon Film	470	5	$\frac{1}{4}$W
R130	Carbon Film	2.2K	5	$\frac{1}{4}$W
R131	Carbon Film	220	5	$\frac{1}{4}$W
R133	Carbon Film	680	5	$\frac{1}{4}$W
6.2 Capacitors				
C1	Metal Foil	0.047	20	630V
C2	Ceramic disc trimmer	2-6pF		
C3	Polystyrene	150pF	2.5	125V
C4	Ceramic disc trimmer	2-6pF		
C5	Polystyrene	0.0047		125V
C6	Polystyrene	0.1	20	250V
C8	Electrolytic	22		63V
C9	Electrolytic	100		25V
C10	Polyester	0.1	20	250V
C11	Polyester	2.2	10	100V
C13	Electrolytic	220		10V
C14	Electrolytic	220		10V
C15	Electrolytic	150		16V
C16	Electrolytic	220		10V
C17	Polystyrene	0.0016	2.5	10V
C18	Polystyrene	780pF	2.5	30V
C19	Polystyrene	780pF	2.5	30V
C20	Electrolytic	10		15V

Circuit Ref	Description	Value	Tol. %	Rating
C21	Polystyrene	0.1	20	250V
C22	Polystyrene	0.0047	2.5	30V
C23	Electrolytic	10		25V
C24	Polyester	0.1	20	250V
C25	Polyester	0.1	20	250V
C26	Electrolytic	10		25V
C27	Trimmer	4-40pF		
C28	Polyester	0.1	20	250V
C29	Polystyrene	30pF	2.5	125V
C30	Polyester	0.1	20	250V
C31	Polyester	0.1	20	250V
C32	Polyester	0.1	20	250V
C33	Polyester	0.1	20	250V
C34	Electrolytic	10		15V
C35	Polystyrene	40pF	2.5	30V
C36	Polyester	0.1	20	250V
C37	Polyester	0.1	20	250V
C38	Polyester	0.1	20	250V
C39	Electrolytic	10		25V
C40	Polyester	0.1	20	250V
C41	Polystyrene	30pF	2.5	30V
C42	Polyester	0.1	20	250V
C43	Polyester	0.1	20	250V
C44	Polyester	0.1	20	250V
C45	Electrolytic	150		16V
C46	Trimmer	4-40pF		

Circuit Ref.	Description	Value	Tol. %	Rating
C47	Polystyrene	0.001	2.5	30V
C48	Polystyrene	0.0035	2.5	30V
C49	Polyester	0.01	20	250V
C50	Polystyrene	0.001	2.5	30V
C51	Polystyrne	910pF	2.5	30V
C52	Polystyrene	0.0016	2.5	30V
C53	Polystyrene	780pF	2.5	30V
C54	Polystyrene	0.0039	2.5	30V
C55	Polystyrene	0.0023	2.5	30V
C56	Electrolytic	150		16V
C57	Electrolytic	100		25V
C58	Electrolytic	330		10V
C59	Electrolytic	10		25V
C60	Electrolytic	10		25V
C61	Electrolytic	150		16V
C62	Electrolytic	150		16V
C63	Polystyrene	15pF	2.5	30V
C64	Polyester	0.1	20	250V
C65	Polystyrene	0.001	2.5	30V
C66	Polystyrene			A.O.T.
C67	Trimmer	5-60pF		
C68	Polyester	0.1	20	250V
C69	Trimmer	5-60pF		
C70	Polystyrene			A.O.T.
C71	Polystyrene	680pF	2.5	30V

Circuit Ref.	Description	Value	Tol. %	Rating
C72	Polystyrene	800pF	2.5	30V
C73	Electrolytic	10		25V
C74	Trimmer	5-60pF		
C75	Polystyrene	82pF	2.5	30V
C76	Variable, type C28-143 three sections nom. cap. for each section	97.1pF		
C77	Polyester	0.1	20	250V
C78	Polyester	0.1	20	250V
C79	Electrolytic	150		16V
C80	Electrolytic	150		16V
C81	Electrolytic	10		25V
C82	Electrolytic	100		10V

6.3 Coils

T1	Transformer Assy Drg. No. BA1275
T2	Transformer Assy Drg. No. BA1276
T3	Transformer Assy Drg. No. BA1277
T4	Transformer Assy Drg. No. BA1277
T5	Transformer Assy Drg. No. BA1279
T6	Transformer Assy Drg. No. BA1279
L1	Coil Assy Drg. No. BA1622
L2	Coil Assy Drg. No. BA1617
L3	Coil Assy Drg. No. BA1618
L4	Coil Assy Drg. No. BA1620

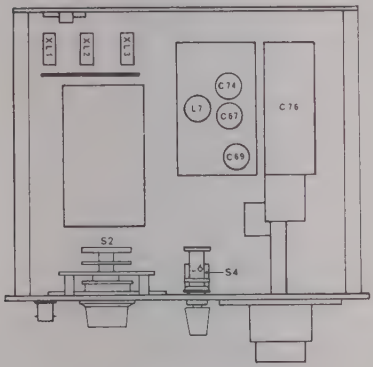
Circuit Ref.	Description	Value	Tol. %	Rating
L5	Coil Assy Drg. No. BA1621			
L6	Coil Assy Drg. No. AA1623			
L7	Coil Assy Drg. No. BA1272			
6.4 Semiconductors				
VT1	Transistor Mullard BC108			
VT2	Transistor Mullard BC108			
VT3	Transistor Mullard BC108			
VT4	Transistor Mullard BC108			
VT5	Transistor Mullard BC108			
VT6	Transistor Mullard BC108			
VT7	Transistor Mullard BC108			
VT8	Transistor Mullard BC108			
VT9	Transistor Mullard BC108			
VT10	Transistor Mullard BC108			
VT11	Transistor Mullard BC108			
VT12	Transistor Mullard BC108			
VT13	Transistor Mullard BC108			
VT14	Transistor Mullard BC108			
VT15	Transistor Mullard BC108			
VT16	Transistor Mullard BC108			
VT17	Transistor Mullard BC108			
VT18	Transistor Mullard BC108			
VT19	Transistor Mullard BC108			
VT20	Transistor Mullard BC108			

Circuit Ref.	Description	Value	Tol. %	Rating
VT21	F.E.T. Transistor Texas BFW56			
VT22	Transistor Mullard BC159			
VT23	F E T. Transistor Texas BFW56			
D1	Diode, Germanium Mullard OA91			
D2	Diode, Germanium Mullard OA91			
D3	Diode, Germanium Mullard OA91			
D4	Diode, Germanium Mullard OA91			
D5	Diode, Germanium Mullard OA91			
D6	Diode, Germanium Mullard OA91			
D7	Zener Diode Mullard BZY 88/C6V2			
D8	Diode, Germanium Mullard OA91			
D9	Diode, Germanium Mullard OA91			
D10	Diode, Germanium Mullard OA91			
D11	Diode, Germanium Mullard OA91			
D12	Variable Cap. Diode I.T.T. BA110			
6.5 Miscellaneous				
RV1	Potentiometer W/W Part of Assy. of S1	25K		
RV2	Potentiometer Carbon linear Radiohm PR14	500	20	
RV3	Potentiometer Carbon linear Radiohm PR14	500	20	
RV4	Potentiometer W/W linear Welwyn P26	2.5K		

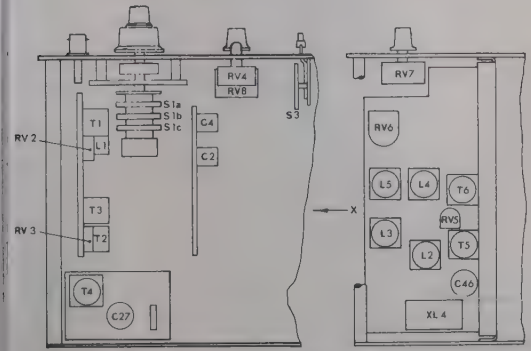
Circuit Ref.	Description	Value	Tol. %	Rating
RV5	Potentiometer Carbon linear Guest PN10B	1K	20	
RV6	Potentiometer Carbon linear Radiohm PR14	10K	20	
RV7	Potentiometer W/W linear Colvern CLR1106/10	25K		
RV8	Potentiomater W/W linear Colvern CLR1106/11	1K		
XL1	Crystal Spec. BD1646/1 Freq. 99.995kHz			
XL2	Crystal Spec. BC1646/2 Freq. 100.005 kHz			
XL3	Crystal Spec. BD1646/3 Freq. 100.000 kHz			
XL4	Crystal Spec. BD1646/4 Freq. 100.000 kHz			
S1	Input Switch Drg. No. BD1519			
S2	Range Switch Drg. No. BD1520			
S3	Toggle Switch Drg. No. AD1666			
S4	Toggle Switch Drg. No. AD1640			
SK1	BNC Bulkhead Socket GE35027			
SK2	BNC Bulkhead Socket GE35027			

Circuit Ref.	Description	Value	Tol. %	Rating
6.6 Power Supply Components				
R1	Metal Oxide	316K	1	½W
R2	Carbon	2.2K	10	½W
R3	Carbon	22K	10	½W
R4	Carbon	4.7K	10	½W
R5	Carbon	2.2K	10	½W
R6	Carbon	10K	10	½W
R7	Carbon	10K	10	½W
R8	Carbon	10K	10	½W
R9	Metal Oxide	820	5	10W
RV1	Preset	2.5K		
C1	Ceramic	.033μF		25V
C2	Electrolytic	10μF		16V
C4	Electrolytic	100 μF		40V
C5	Electrolytic	150μF		100V
C6	Electrolytic	150μF		100V
C7	Electrolytic	1000μF		40V
VT1	R.C.A.2N 5296			
VT2	Texas BC183 LA			
VT3	Texas BC183 LA			
VT4	Texas BC183 LA			
VT5	R.C.A. BSY 90			

Circuit Ref.	Description
D1	Mullard BZY88-C6V2
D2	Mullard BZY88-C6V2
D3	Westinghouse S1M1
D4	Westinghouse S1M1
D5	Westinghouse S1M1
D6	Westinghouse S1M1
T1	Transformer 40/1024
F1	Fuse Type F286 150mA
S1	Combined Push-Button Switch, Special
S2	Combined Push-Button Switch, Special
S3	Combined Push-Button Switch, Special
S4	Slider Switch D. P. D. T. Diamond H Type 278
SK1	Socket McMurdo PS6
ME1	Meter 100μA

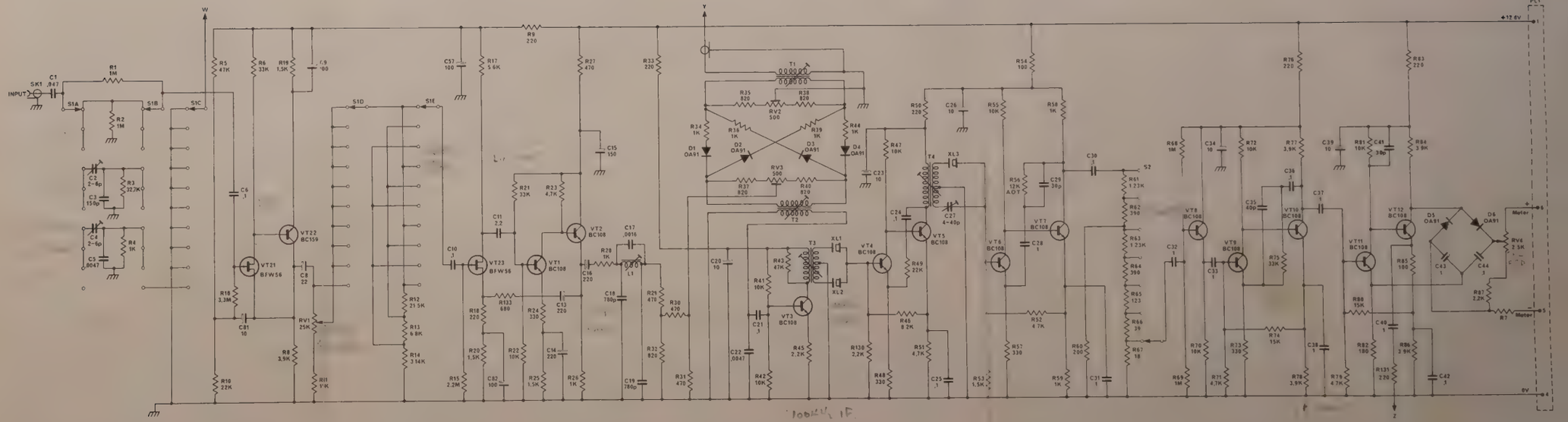


VIEW ON TOP OF CHASSIS



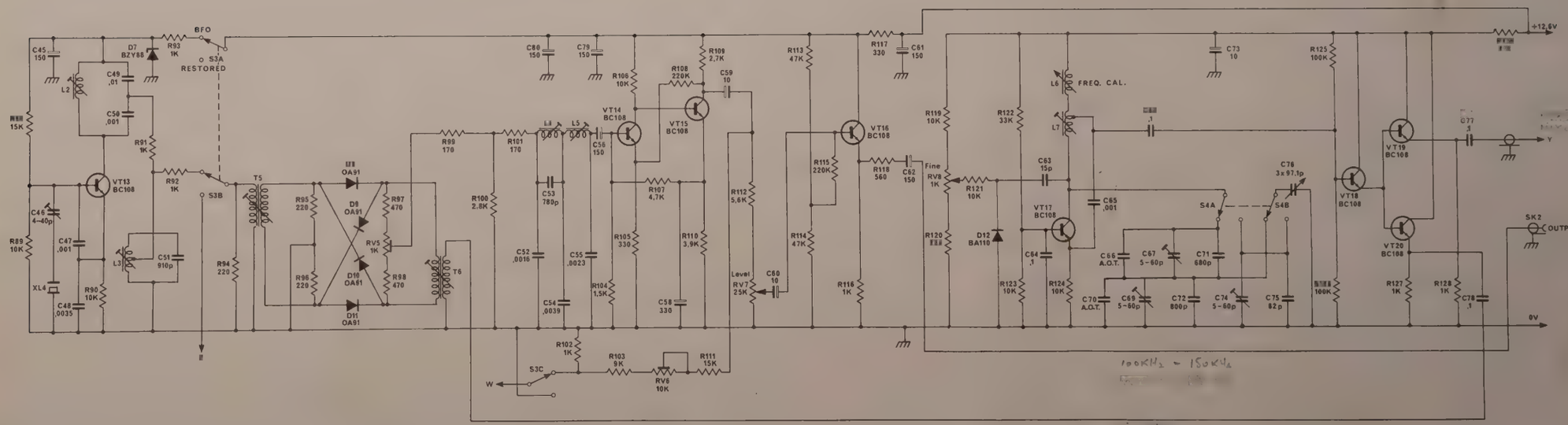
VIEW UNDER CHASSIS

VIEW ON ARROW 'X'



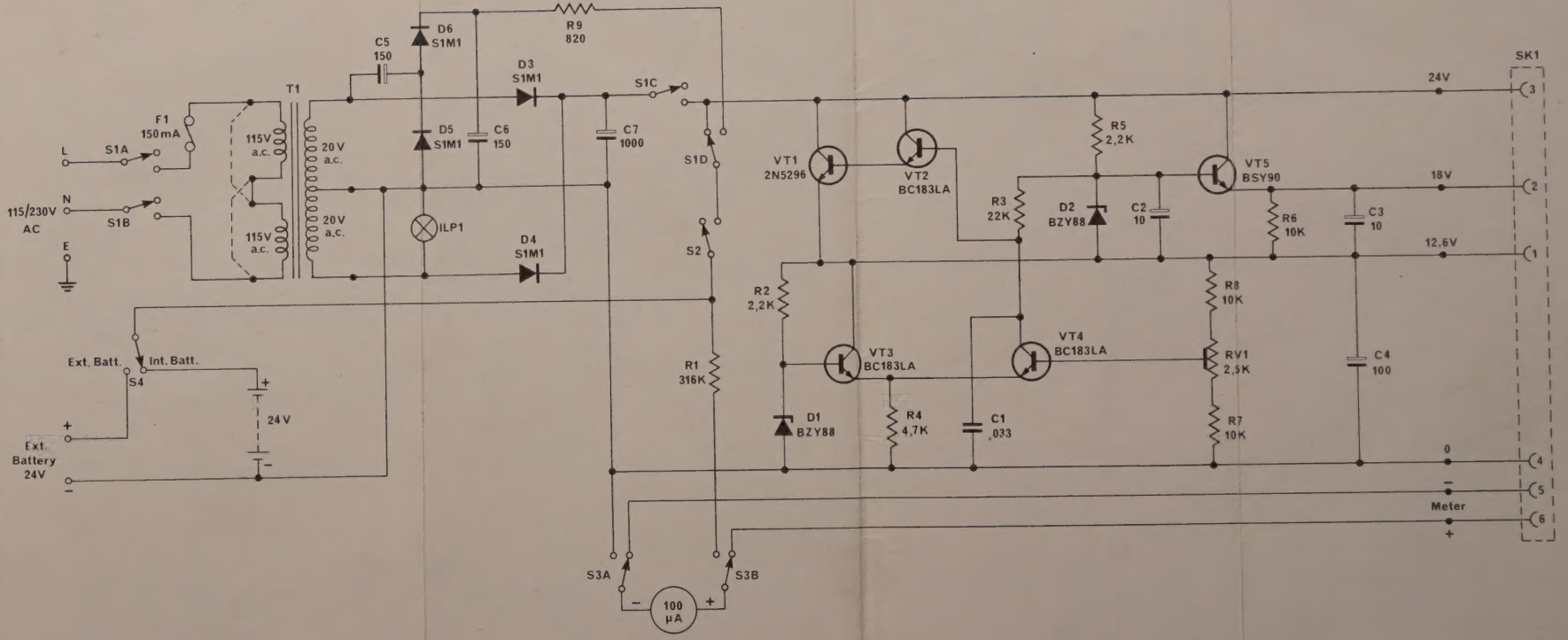
Circuit Diagram for
A.F. Wave Analyzer Type 1771

AO-102024 Sheet No. 1



Circuit Diagram for
A. F. Wave Analyzer Type 1771

AO-102024 Sheet No. 2



Power Supply Unit

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